

# PROJECT FACT SHEET

**CONTRACT TITLE:** Design and implementation of a CO2 Flood Utilizing Advanced Reservoir Characterization and Horizontal Injection Wells in a Shallow Shelf Carbonate Approaching Waterflood Depletion -- Class II

**ID NUMBER:** DE-FC22-94BC14991

**B&R CODE:** AC1010000

**CONTRACTOR:** Phillips Petroleum Co.  
Exploration & Production

**ADDR:** Permian Profit Center  
4001 Penbrook  
Odessa, TX 79762

**DOE PROJECT MANAGER:**

**NAME:** Daniel J. Ferguson  
**LOCATION:** NPOT  
**PHONE:** 918/ 699-2047  
**E-MAIL:** dan.ferguson@npto.doe.gov

**CONTRACT PROJECT MANAGER:**

**NAME:** Kirk Czirr  
**PHONE:** 915/ 368-1203  
**FAX:** 915/ 368-1330  
**E-MAIL:** klcirr@ppco.com

**PROJECT SITE**

**CITY:** Odessa **STATE:** TX  
**CITY:** South Cowden Unit, Ector **STATE:** TX  
**CITY:** County **STATE:**  
**CITY:**

**CONTRACT PERFORMANCE PERIOD:**

6/30/1994 to 7/2/2001

**PROGRAM:** Reservoir Life Extension  
**RESEARCH AREA:** Seismic/Class 2  
**PRODUCT LINE:** ADIS

**CO-PARTICIPANTS:**

<b>PERFORMER:</b>	<b>CITY:</b>	<b>STATE:</b>	<b>CD:</b>
<b>PERFORMER:</b>	<b>CITY:</b>	<b>STATE:</b>	<b>CD:</b>
<b>PERFORMER:</b>	<b>CITY:</b>	<b>STATE:</b>	<b>CD:</b>
<b>PERFORMER:</b>	<b>CITY:</b>	<b>STATE:</b>	<b>CD:</b>

FUNDING (1000'S)	DOE	CONTRACTOR	TOTAL
PRIOR FISCAL YRS	6935	14311	21246
FY 2002 CURRENT OBLIGATIONS	0	0	0
FUTURE FUNDS	0	0	0
TOTAL EST'D FUNDS	6935	14311	21246

**OBJECTIVE:** Demonstrate the economic viability and widespread applicability of an innovative reservoir management and carbon dioxide (CO2) flood project development approach for improving CO2 flood project economics in shallow shelf carbonate reservoirs. The use of several horizontal injection wells drilled from a centralized location will reduce the number and cost of new injection wells, wellheads, and equipment; allow concentration of the surface reinjection facilities; and minimize the cost associated with the CO2 distribution system. It is anticipated that the proposed advanced technology will show improved CO2 sweep efficiency and will significantly reduce the capital investment required to implement a CO2 tertiary recovery project relative to conventional CO2 flood pattern developments using vertical injection wells. This technology will be readily transferred to the domestic oil industry.

**PROJECT DESCRIPTION:**

**Background:** The principal objective of this project is to demonstrate the economic viability and widespread applicability of a CO2 flood project utilizing multiple horizontal CO2 injection wells. The Grayburg and San Andres formations were deposited in shallow carbonate shelf environments along the eastern margin of the Central Basin Platform. The primary target for CO2 flood development under the proposed project is a 150-200 ft gross interval within the San Andres located at an average depth of 4,550 ft. The original oil in place for the South Cowden Unit is estimated to be less than 180 million barrels. The field was discovered in 1940 and unitized for secondary recovery in 1965. The Grayburg-San Andres section had previously been divided into multiple zones mapped as continuous across the field. Previous core studies concluded that reservoir quality in South Cowden field is controlled primarily by distribution of a bioturbated and diagenetically altered rock type.

**Work to be Performed:** The principal objective of this project is to demonstrate the economic viability and widespread applicability of a CO2 flood project utilizing multiple horizontal CO2 injection wells. The Grayburg and San Andres formations were deposited in shallow carbonate shelf environments along the eastern margin of the Central Basin Platform. The primary target for CO2 flood development under the proposed project is a 150-200 ft gross interval within the San Andres located at an average depth of 4,550 ft. The original oil in place for the South Cowden Unit is estimated to be less than 180 million barrels. The field was discovered in 1940 and unitized for secondary recovery in 1965. The Grayburg-San Andres section had previously been divided into multiple zones mapped as continuous across the field. Previous core studies concluded that reservoir quality in South Cowden field is controlled primarily by distribution of a bioturbated and diagenetically altered rock type.

**PROJECT STATUS:**

**Current Work:** The DOE participation in this project ended on July 2, 2001. The major well workovers identified in the re-development plan approved in late 1999 were completed in April 2001. Those workovers consisted of drilling horizontal laterals from existing vertical wellbores in four producers in Phase 1, five injectors in Phase 2A and four producers in Phase 2B. Without the initiation of CO2 the South Cowden Unit would have reached it's economic limit under waterflood.

**Scheduled Milestones:**

Complete Final Report (Pending)

07/01

**Accomplishments:** CO2 injection commenced in two horizontal wells during August 1996, and in the two vertical wells during September 1996. First production of CO2 occurred in late 1996 in five wells immediately offsetting the horizontal injection wells. Three lease line CO2 injection wells were drilled in late 1996. New memory logging technology using coiled tubing was utilized to run injection profile logs while under both water and CO2 injection in the horizontal injectors. CO2-contaminated produced gas is being compressed and re-injected. Improvements to withdrawal rates have been achieved with the use of designed scale treatments. There were forty eight producers and twenty injectors active in 1997. New injection wells were completed in 1996-97 and two horizontal and three vertical wells were drilled in 1997-98. An additional sixteen wells were converted or re-activated.

Total production rate has been less than originally predicted. A major cause has been identified as out-of-zone injection of CO2. A second problem has been lower than expected production rates for both oil and water. A three part re-development program was designed to address the problems identified. Short radius lateral drilling was implemented in the first half of 2000 to improve injection rates and to keep the injectant in the target zones. In Phase 1, single laterals were drilled in four producers. In Phase 2A, dual laterals were drilled in four injection wells and a single lateral was drilled in one other injection well. In Phase 2B, single horizontal laterals were drilled in four producers. Phases 1 and 2B have resulted in current production increases of 100 barrels of oil per day each for a total of 200 barrels of oil per day increase in production. These laterals have been moderately successful in keeping CO2 injection "in zone" and increasing the total production rate of oil and water from those pay zones.

**TECHNOLOGY TRANSFER:**

**Technology/Information Transfer:** No recent activity.

**Public Relations:** Phillips Petroleum public relations contact:

Kristi Desjarlais  
1680 Phillips Building  
Bartlesville, Oklahoma 74004  
(918) 661-6117

Odessa American newspaper  
Business Reporter, Julie Breau (915) 337-6262

Midland Reporter Telegram newspaper  
Business Reporter, Melba McEwen (915) 687-8860

Updated By: Dan Ferguson

Date: 1/14/2002